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## ABSTRACT

Collective front-end analysis is the process by which the critical missions and collective tasks of a battalion are specified. Collective tasks are units of work requiring two or more people for their completion. A mission-based approach is employed in CFEA. The CFEA process begins with specification of a battalion mission, proceeds to specification of battalion element missions, and ends with delineation and description of collective tasks. The mission-based approach to CFEA is advantageous because it helps ensure a thorough listing of a unit's collective tasks and provides a means of relating task criticality directly to a unit mission. In order to reduce the workload on the user and help organize the massive amounts of data involved, user job aids were prepared.

## INTRODUCTION

Most scenarios for full scale confrontation between the United States and any of its major adversaries describe a "come as you are war" in which the U.S. will have to fight immediately without the luxury of a lengthy mobilization period as enjoyed in previous wars. This rapid response environment in which U.S. forces must exist requires that fighting units establish and maintain high readiness levels. An important factor influencing a unit's readiness is the training it receives. Development of effective unit training is predicated upon the ability to identify performances that are critical to accomplishment of the unit's mission. Among the performances that support accomplishment of a unit's mission are many tasks that require teams or collectives of personnel for their performance. Traditionally, front-end analysis efforts have failed to address collective tasks or have addressed them inadequately. As a result, training of collective or team performance in units has suffered.

Recognizing the importance of team performance to unit readiness, the Army has recently been concerned with developing a means of identifying collective tasks. As defined by TRADOC PAM 310-8, (1) collective front-end analysis (CFEA) is the process by which the critical missions and collective tasks of a battalion are specified. This paper provides a brief description of an approach to CFEA, discusses issues pertaining to application of CFEA, and describes job aids used in the CFEA process.

## APPROACH TO CFEA

A battalion is a large organization and one would expect its personnel to perform a large number of collective tasks. A method for delineating collective tasks is needed that can offer some assurance that a thorough listing of collective tasks will be provided. Once the collective tasks in a unit have been specified, those performances must be evaluated to determine which ones warrant the expenditure of training resources. An important factor determining the need for training a task is the extent to which deficiencies in task performance influence outcome of a unit mission. Thus, the method employed to derive a unit's collective tasks should allow

for determination of the relationship between a given task and a unit's mission.

An approach to CFEA has been adopted that addresses both of the above problems. The approach to CFEA is described as mission-based. It is described as such because the mission of the unit to be analyzed is taken as the point of departure for the analysis. The CFEA process employs techniques of systems analysis (2,3) and begins with specification of the unit mission(s) or objective(s), proceeds to specification of battalion element missions, and ends with delineation and description of collective tasks. The process is organized into two major phases: the mission analysis and the task analysis. Figure 1 presents the major steps involved in CFEA. Figure 2 depicts the relationship between the major products of CFEA and the phases of the analysis. A brief description of the CFEA process is provided below. A discussion of the advantages of the mission-based approach follows.

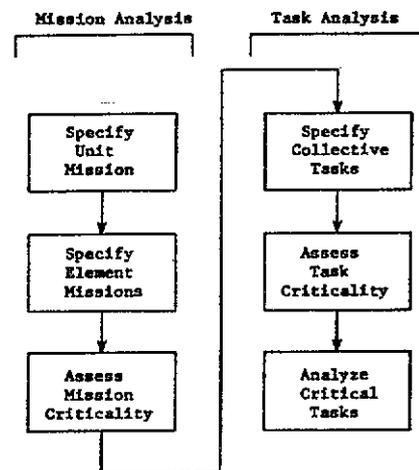


Figure 1. Major Steps in CFEA

Phase of CFEA

Major CFEA Products

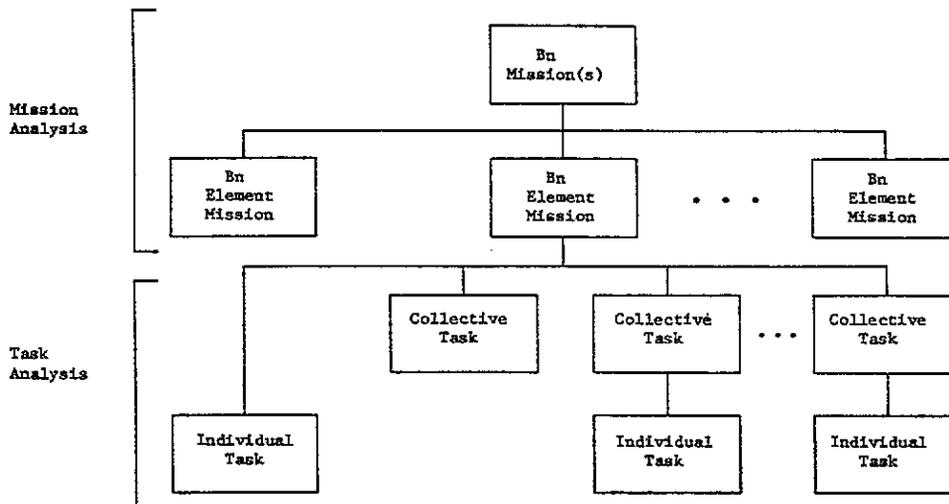


Figure 2. Relationship of Major CFEA Products and Phases of CFEA

The CFEA Process

As indicated in Figure 1, the mission analysis begins with development of mission statements that describe the objectives of the unit under analysis. Statements are formulated that reflect the capabilities of the unit's personnel and equipment (e.g., the mission of an air defense battalion would be to provide low to medium altitude air defense) and requirements imposed upon the unit by its parent organization (e.g., a unit attached to the Rapid Deployment Force would have the mission of rapid deployment via air or sea).

Once the unit's mission has been established, attention is turned to specifying the missions performed by each of the unit's organizational elements as they support accomplishment of the unit mission. Specification of element missions is accomplished by determining the types of functions that are required to accomplish the unit mission (e.g., plan, direct, engage, service, repair, rearm, refuel, feed, etc.), describing the organizational structure of the unit, and allocating the different functions to organizational elements. For each element, a statement or series of statements are prepared that describe the specific nature of the function(s) performed by the element.

After battalion element missions have been specified they are assessed to determine their criticality. Criticality of a battalion-element mission is primarily a function of three factors: its direct effects on the battalion mission, its effects on the ability of the battalion to sustain operations and its effects on ability of the battalion to survive on the battlefield. If failure of a mission affects unit functioning in any of these areas, the mission is deemed critical.

When the assessment of mission criticality is complete, the task analysis phase begins. This phase consists of three steps. First, each critical battalion element mission is analyzed to determine the collective tasks that support it. Derivation of collective tasks is accomplished by describing all of the activities that are involved in performing a given mission, grouping the activities into units of behavior constituting tasks, and determining which are performed by collectives of personnel.

Next, the collective tasks are assessed to determine their criticality for training. A primary factor affecting a task's criticality is its influence on the battalion element mission it supports. Tasks whose success or failure affect mission success are considered for training. Tasks that are difficult or hazardous to perform, or are performed infrequently and easily forgotten are given high priority for training.

Finally, critical tasks are subjected to a detailed analysis which produces operational sequence diagrams (OSDs). Operational sequence diagrams display the flow of task performances and the interactions among performers. Task conditions and standards are specified in the same manner as for individual tasks.

Advantages of the Mission-Based Approach

The major products of CFEA are the battalion mission(s), battalion element missions, and collective tasks. These products are used to develop Army Training and Evaluation Plans (ARTEPs), drills, and other training materials. Studying relationships between CFEA products depicted in Figure 2, several features of the mission-based

approach to CFEA are apparent. First, development of mission-oriented training is facilitated because the tasks that support a given mission are specified. Second, because the starting point of the analysis is a battalion mission, it is assured that all subsequent products are mission relevant. Third, breaking the battalion mission into battalion element missions prior to specifying collective tasks helps ensure a thorough listing of tasks. The battalion element missions provide a means of subdividing the area in which the search for collective tasks occurs. Each battalion element mission focuses the task analyst's attention in a circumscribed area, decreasing the likelihood that important tasks will be overlooked. Finally, the mission-based approach to CFEA allows for a more accurate assessment of task criticality. The relationship of a particular task to a battalion mission can be traced through the battalion element mission that the task supports. A task's criticality can be determined by jointly considering the criticality of a task to the battalion element mission it supports and the criticality of that battalion element mission to the battalion mission.

It should be noted that the traditional job-based approach to front-end analysis does not offer the benefits of the mission-based approach. In the job-based approach the task analyst attempts to inventory the tasks performed in a given job. Use of a job-based approach to CFEA would result in a thorough listing of tasks only if the jobs in the unit combine to fulfill all of the unit's requirements for successful functioning. This situation is probably not the case given the fact that jobs in most units have evolved as a function of equipment utilized or changes in unit structure rather than on the basis of requirements dictated by a unit's mission. Further, the assessment of task criticality is more difficult in the job-based approach because the relationship between collective tasks and a battalion mission cannot be traced explicitly. Finally, because missions and the relationships between missions and tasks are not specified in the job-based approach, mission-oriented training cannot be developed.

#### ISSUES IN CFEA APPLICATION

Ultimately, the objective of CFEA is to provide inputs for development of training programs that will enable a unit to perform its mission. There are, however, issues regarding conduct of CFEA that impact the products generated and, hence, the training programs subsequently derived. Review of training materials that use CFEA products (e.g., ARTEPs) indicates there is disagreement over what constitutes a collective task. In addition, there is some question as to the proper scope of CFEA. Both of these issues are discussed below.

#### The Need for Precise Definition of Collective Tasks

The effectiveness of training programs developed using CFEA products is partly dependent upon how precisely the performances to be trained are specified. In preparing collective task statements users should give careful consideration to the definition of a collective task. Proper collective task statements should reflect units of work that are performed by two or more people, have a definite beginning and end, and have purpose in and of themselves.

All too often, however, it seems that collective tasks have been confused with collections of tasks. For example, in a recent Army Training and Evaluation Program (ARTEP) one of the collective tasks listed was to perform periodic checks. Periodic checks is a class of preventive maintenance tasks, some of which are performed by individuals and some of which are performed by collectives. Such task statements are inappropriate for training development purposes because they are not specific enough and must be further analyzed in order to determine what is to be trained. In an effort to aid specification of collective tasks, a set of criteria for evaluating performances is offered below.

When developing collective task statements the analyst should review each performance under consideration and try to specify its start and end points. If these points can be determined, the statement does reflect a task. Next, the analyst should examine the task to ensure that it is in fact a collective as opposed to an individual task. There are several circumstances that give rise to collective tasks and the analyst should determine whether any apply to the task under consideration. First, some tasks require use of skills found in two or more specialties. Other tasks require simultaneous performance of task steps in different locations. Finally, performance of a task can require such a large number of skills that it would be impossible for one person to perform the task in a timely or otherwise effective fashion. Activities meeting these criteria are collective tasks.

#### The Scope of CFEA

The stated objective of CFEA is to specify and describe collective tasks. Unfortunately, if the scope of CFEA is limited to specifying collective tasks, important individual tasks that support accomplishment of a battalion element mission may be overlooked. The relationships between missions and collective and individual tasks are depicted in Figure 2. Note that in some instances collective tasks are composed of individual tasks. In others, individual tasks do not support collective tasks but stand alone in direct support of a battalion element mission. Many maintenance, administrative, and supervisory tasks, for example, are performed by individuals. Therefore, the objective of CFEA should be to specify all of the performances (both collective and individual) that support accomplishment of a battalion-element mission. This orientation to CFEA will enable development of training programs that support all aspects of mission performance.

Given the size of the units analyzed and the massive amounts of data that are generated, CFEA can seem overwhelming to a task analyst. In designing a process for conducting CFEA, an objective has been to provide procedures that can be readily employed by Army training developers. Development of procedures was based on recognition of the fact that front-end analysis is a somewhat subjective process that cannot be algorithmized to the extent that the task analyst need not make decisions or judgments. Given that some decision making is required in CFEA, the concern was to design procedures such that the amount of information to be manipulated by the user at any one point in the process is minimized. This was accomplished by breaking the process into steps and developing job aids whenever possible. As in other training development and evaluation processes such as the Training Developer's Decision Aid (TDDA)<sup>(5)</sup> and the Training Evaluation and Cost Effectiveness Program (TECEP),<sup>(6)</sup> job aids were developed for CFEA to facilitate organization of data and decision making. Examples of two job aids used in CFEA are presented below.

As many as 150 to 200 battalion element mission statements might be generated in a CFEA. The process of developing this many mission statements can be time consuming and tedious. Also, because of the large number of element missions performed in a battalion, it is easy to overlook some. In order to speed the process of specifying these missions and to help ensure thorough coverage, CFEA users are provided with a matrix of job aids. The job aid includes a list of generic functions which serve as prompts for developing mission statements. One job aid is for specifying classes of mission functions that apply to battalion elements. Mission function classes are major groups of functions that are performed in support of battalion missions. The three mission function classes used in CFEA are combat operations, support, and survival. This job aid, presented in Figure 3, consists of a battalion element by function class matrix. The user enters 'X's into the appropriate cells of the matrix to indicate the function classes that apply to each element.

Bn Elements	Combat Operations	Support	Survival
Bn Hq	X	X	X
OP/INTEL	X		X
Fire Direction	X	X	X
Admin.		X	X
Transportation		X	X
Medical		X	X
Motor Maintenance		X	X
Base Fire Platoon	X		

Figure 3. Illustration of Allocation of Battalion Elements to Mission Function Classes

Next, elements identified as performing functions of a given class are compared against the functions that make up that class. Once again, a matrix job aid is used to identify and record the functions performed by each element. An example of such a job aid used to relate functions to elements of an air defense battalion is provided in Figure 4. Finally, specific statements of element missions are developed using the generic functions designated in the Figure 4 job aid as a point of departure.

Bn Element	Support Functions						
	Rearm	Refuel	Service	Repair	Transport	Resupply Materiel	Supply Power
Fire Direction			X	X			
Bn Supply	X	X				X	
Motor Maint.		X	X	X			X
System Support Plt.	X		X	X			X
Transportation					X		

Figure 4. Example of Allocation of Battalion Elements to Functions in a Mission Function Class

While it is true that actual specification of battalion element missions requires some judgment or creativity on the part of the analyst, this process is facilitated by use of the job aids which prompt development of mission statements. In addition, generic function lists presented in the job aids help provide a thorough listing of element missions because they serve as cues for the recall of missions. Finally, use of these job aids is important because of the manner in which they control the user's attention. The cells of a given matrix force the user to consider in isolation each element in conjunction with each function. Thus, the amount of information to be considered by the user at any point in the process is minimal and the likelihood of a thorough listing of missions is enhanced.

#### References

- (1) U.S. Army Training and Doctrine Command. Collective front-end analysis (draft) (TRADOC PAM 310-8). Ft. Monroe, VA, Author, 1981.
- (2) Meister, D. Human factors. Theory and practice. New York: John Wiley and Sons, 1976.
- (3) Whitmore, P., Fry, J., and Cason, G. Systems engineering of training soft skills. Alexandria, VA: Human Resources Research Organization, January 1971.
- (4) Kurke, M. Operational sequence diagrams in system design. Human Factors, Vol. 3(1), 1961, 66-73.
- (5) Frederickson, E., Whitmore, P., Wood, M., Hawley, J., Brett, B., and Chapman, W. Air defense training developer decision aid: Model extension and research requirements. Valencia, PA: Applied Science Associates, Inc., November 1981.
- (6) Braby, R., Henry, J.M., Parrish, W.F., and Swope, W.M. A technique for choosing cost-effective instructional delivery systems. (TAEG Report No. 16). Orlando, FL: Training Analysis and Evaluation Group, April 1975.

#### ABOUT THE AUTHOR

MR. BRYAN E. BRETT is a Senior Staff Scientist with Applied Science Associates, Inc., El Paso, Texas. He is currently involved with projects in the area of training development. Specific issues addressed in these projects are development of collective front-end analysis procedures, evaluation of training device capabilities, and measurement and modeling of operator performance in air defense systems. He holds a Master's degree from the University of Florida in Experimental Psychology.

